

this freezing of the surface soil, especially where continuing over so long a period as noted above, may injure the hair roots near the surface of the ground and thus weaken the tree.

TABLE 5.—Effect of cover crop on amount of temperature, °F., inversion near ground.

[Average minimum temperature on clear nights.]

SHELTERED THERMOMETERS.

	North plot.			South plot.		
	5-foot elevation.	10-inch elevation.	Difference.	5-foot elevation.	10-inch elevation.	Difference.
Both plots in cover crop.....	31.5	30.7	—0.8	30.9	30.1	—0.8
North plot in cover crop; south plot clean cultivation.....	26.9	27.0	+0.1	26.2	25.4	—0.8

UNSHeltered THERMOMETERS.

	North plot.			South plot.		
	24-inch elevation.	7-inch elevation.	Difference.	24-inch elevation.	10-inch elevation.	Difference.
Both plots in cover crop.....	29.4	27.8	—1.6	28.3	27.1	—1.2
North plot in cover crop; south plot clean cultivation.....	25.4	25.5	+0.1	23.9	22.4	—1.5

The unsheltered thermometers show this in a somewhat greater degree. (See Tables 4 and 5.)

The bare soil probably was warmed up to a depth of 2 or 3 inches during the day, and this heat was conducted to the surface during the night, partially maintaining the temperature of the surface layer of air. On the other hand, the cover crop shaded the soil, preventing its warming up to any considerable extent during the day and also acted as an insulating agent between the surface of the soil and the surface layer of the air during the night.

It is not possible to draw a definite conclusion from observations covering only one frost season, but all the evidence obtained thus far indicates that a cover crop has little effect on the temperature a few feet above the ground. If this conclusion is borne out by experiments, which it is hoped to carry out in later seasons, any increased damage to fruit by frost in a cover-cropped citrus grove must be attributed to some other agency than a depression of the air temperature by the cover crop. If the greater damage found in cover-cropped groves can not be explained by natural differences in temperature, due to difference in elevation or other such cause, the answer may be found in a physiological effect of the cover crop on the tree.

One of the principal effects of the cover crop on the temperature is due to its shading the ground and thus preventing the warming of the soil during the day. This effect is discounted, however, in a citrus grove of old trees, because the trees themselves shade a large proportion of the ground and prevent the sun's rays from warming the soil to the extent that would be the case if there were no trees present. It readily can be seen that the effect of a cover crop in depressing the temperature on a clear, calm night would be greater in a grove of young trees, and still greater in an alfalfa field, without trees.

An interesting point brought out in this work was the fact that there was no temperature inversion within 5 feet of the ground over the clean cultivated area. There was a difference of nearly a degree between the 5-foot shelter and the ground shelter while the cover crop remained, but this difference disappeared entirely when the cover crop was removed. This is brought out in Table 5.

A SECOND EXPERIMENT ON COVER CROPS.

A second experiment with the object of determining the influence of a cover crop on the frost hazard was carried on by Mr. Eckley S. Ellison, observer, U. S. Weather Bureau, on the property of the Fontana Farms Co., near Fontana, Calif. That settlement is situated in extreme southern San Bernardino County about 45 miles due east of the town of San Bernardino.

Mr. Ellison's observations were made at the 5-foot level above the ground on a clean cultivated area and on one that was covered with grass and clover. A portion of the experimental plot was plowed under and the observations continued. His conclusions as given in his own words follow:

Results obtained in this experiment tend to show that a cover crop increases the frost hazard, although the amount of the increase is so small as to be practically negligible. At a distance of 5 feet above the ground, the lowering of temperature amounts to less than half a degree F. Also the duration of critical temperatures is not affected to any practical extent regardless of the condition of the surface, whether cropped or clean.

It might be that when large areas are planted to cover crops the influence on the temperature would be more marked, but it is the writer's belief that even then no considerable influence would result, due to the relatively small effect detected when a plot of 5 acres is used as a basis of comparison.

Since the effect of a cover crop, although small, can be noted at an elevation of 5 feet, there is reason to suppose that from that height down to the surface of the ground a greater influence would be exerted. The results of this experiment can not, therefore, be construed to fit the case of a grower who has a considerable portion of his crop below the 5-foot level. Within the cover crop itself the influence of the vegetation is probably great—two or three degrees at least \* \* \*.

—A. J. H.

CALCULATING TEMPERATURE EXTREMES IN SPOKANE COUNTY, WASH.

By E. M. KEYSER, Meteorologist.

[Weather Bureau, Spokane, Wash., October 19, 1920.]

Whatever degree of success was attained in temperature calculations in Spokane County last spring came as a by-product of the survey work authorized here by the Chief of Bureau. The original stimulus for undertaking these calculations came from a personal knowledge of the work being done in southern Oregon and California by Meteorologist Floyd D. Young. This stimulus was intensified by the various inspirational and very practical articles in MONTHLY WEATHER REVIEW SUPPLEMENT No. 16 (Predicting Minimum Temperatures From Hygrometric Data). The scope was greatly augmented by the

willing and accurate clerical work done by Observer Frank B. Whitney, specially assigned to aid in the survey.

SCOPE OF 1922 TEMPERATURE SURVEY.

Spokane County, 54 miles long and 36 miles broad, touching Idaho on the east, reaches within 66 miles of the Canadian border. In the survey lasting from April 9 to June 13 temperature records were obtained from nine stations outside of Spokane, which is near the center of the county. Five of these were in Spokane Valley east of